

Episode 3: Supply

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Daren: Welcome to the third installment of the Azarias Capital Management uranium podcast series. Azarias Capital specializes in identifying turnaround opportunities in the small-cap universe, and that focus often leads us to industries poised for a cyclical upturn. We believe uranium represents one of the best opportunities in the market today to experience a powerful cyclical recovery. In our first episode in this uranium series, we provided an overview of supply and demand and made our case for why we expect an impending supply deficit to drive the price of uranium to at least double from current levels. In the second episode we provided more background on the demand picture and corrected the misperception that nuclear energy is dying. In fact, it is growing globally at a one to two percent rate. Additionally, we explained why demand is nearly impervious to recessions. Today in this third installment we will dive deeper into the supply side

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of the equation. I'm Daren Heitman, the founder of Azarias Capital, and I'm joined by my colleague and partner, Chris Gillespie. Hey, Chris. How's it going?

Chris: Pretty good. How are you doing?

Daren: Not bad, not bad. Ready to talk some uranium supply with you.

Chris: Alright.

Daren: In our last episode we covered the demand side and the demand is actually very visible and actually very strong. It's only growing at one or two percent but that's plenty for our thesis to play out, and in fact we can afford to be wrong on the demand side because really this is a supply story, and it's playing out the way we have seen other commodity cycles play out. The reason we got involved in uranium to begin with is because we saw the price of the commodity fall below the marginal cost of production and that's what got our interest—and we'll come back to that and talk about marginal cost in greater detail—but because the price of the commodity fell below marginal cost we've been seeing supply come off. And that's really the whole story: we're seeing supply continue to shrink, and we believe that will happen until the market's cleared, and then you'll have a supply deficit, price responds and goes up, and then that will incentivize incremental production and supply will go back up. So,

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before we get into the details of the supply dynamics, let's talk a little bit about what uranium is. So, Chris, what is uranium?

Chris: Uranium is a heavy metal; it's about seventy times denser than lead, and that gives you an indication of sort of how heavy it is; I think it's somewhere around the fiftieth most abundant element in the earth's crust, so it's available around the world to be found, and because of its density it packs a lot of power in a small package.

Daren: Yeah, that's actually, that's a good point. That's a characteristic we didn't even talk about on the demand side which we probably should have. The reason nations like to use nuclear power is because of what you just said: the energy efficiency is terrific, really. So, you mentioned it is fairly easy to find around the world, it's readily available. So, as of today where does most of it come from? What countries are exporting or producing uranium?

Chris: Yeah, I mean it is readily available but it's not always easy to find, you know, large amounts of it in high concentrations and so, right now, as we look at where the supply comes from, Kazakhstan is the largest producer, producer country, of uranium in the world, currently producing about forty percent of supply. And then after that Canada is the next largest supplier, with about fifteen to twenty percent of supply. I

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mean, numbers are moving around a little bit here in terms of supply, but Canada has two large, very high-grade mines. And then when you get beyond those two large producers, then you get into countries like Australia, which is somewhere around ten percent of production; Russia; Namibia; Niger—all in the sort of high-single-digit production levels—and Uzbekistan is also a reasonably-sized producer. So, as you look at it from a big picture, geopolitically you might say that twenty to thirty percent of the production, maybe twenty-five, thirty is coming from nations that are more friendly to the U.S., like Canada and Australia, and then somewhere in the fifty percent-plus-range is coming from countries that are more closely aligned with Russia—that would be sort of Kazakhstan, Russia, and Uzbekistan. And then when you look at Namibia, their production is mostly owned by China so that's sort of dedicated to China. And then, similarly, in Niger there's two mines there that are owned basically by France's power-producing companies, so all that supply goes there.

Daren: Okay, great. Now I'm gonna dive in on at least a couple of those countries that you just mentioned, because Kazakhstan is forty percent of the world's production, and until a few years ago that was a state-owned enterprise. Maybe you can walk through what's happened since then.

Chris: Sure. So yeah, Kazakhstan...it's sort of been a big

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story on the supply side over the past fifteen years. From 2005 to 2018 they went from about nine million pounds of production to fifty-five million pounds, so that was a big increase in supply. They were, until very recently, we understand they were using Soviet accounting until 2017, 2018, so they didn't even really know their full cost of production. Since then they have made a move to become more sort of Westernized in terms of their accounting and then also in terms of their production, so they're trying to, instead of just produce and flood the market, they're trying to sort of maximize value over volume and try to get more dollars per pound as opposed to just pushing out more pounds, which was sort of the old, Soviet-style way of producing. And so, they went public last year, so as a result of that they are also trying to manage more towards profitability, and so we're seeing that in the way they're running the company now. They have, over the past couple years, made several announcements whereby they were cutting back on supply and cutting back on new projects that they were going to do because the price was just too low. And so, they've started to become a better actor in the overall supply picture for uranium. That's a positive development for the market currently and as we look forward.

Daren: There's still a lot of skepticism regarding the Kazakhs' role in the market. I think over the next couple years that skepticism or pessimism will prove

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to be unfounded because not only in real time their actions support our thesis that they are becoming very economic, rational actors, but also you can read interviews by the CEO that have been done over the last couple years that are just words, but his words along with the company's actions really support that they're going to do their part to withhold supply until prices justify incremental production. One other thing on the Kazakhs—the skeptics or the pessimists believe that they have a lot of incremental capacity that they'll flood the market with as soon as prices recover into the forties, or maybe even sooner. What's our view in terms of the Kazakhs' ability to ramp up production?

Chris: You know, we think that they, as I mentioned, they've sort of been holding back on expansion, but we think that they certainly could increase production by something around maybe ten million pounds a year. But, you know, the production method that they use is the in-situ recovery method, which requires a lot of ongoing drilling and ongoing CapEx to ramp that up. And so, we think that it's unlikely that they're going to be able to ramp that production up much beyond an additional ten million pounds a year. And, in addition, they've ramped up production a lot in the last fifteen years and mined the best stuff first, like all mining companies do, and so as they continue to drill new holes and create new mines it gets a little bit harder and the costs go up a little bit.

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So, we think the big Kazakh expansion has happened. There is some debate about their future production. You know, a number of their supply curves actually show supply starting to go down fairly significantly as you go into the back half of the 2020s. So, we're not assuming that, but we're also not assuming any major increase beyond, say, maybe ten million additional pounds. And again, as I already mentioned, as they continue to pursue value over volume, we think it would make sense, as a now-publicly-traded company, to try to maximize the value per pound as opposed to just cranking out pounds.

Daren: Yeah, that's well-stated and I'll just put a bow on that by saying that, first of all our supply estimates include them ramping up once the price recovers into the forty-five to fifty-five dollar range to that sixty-five million pound level, but even if the skeptics are right and they can go beyond sixty-five million pounds a year, they can only do that for a few years, which is what you were implying when you talked about their capital needs and also where their productive assets are. So, the harder they lean on those productive assets, they could ramp up production maybe aggressively for a few years, but all that does is bring forward production, and in the second half of the 2020s it just shifts the supply deficit to a different year. We don't see any scenario where the Kazakhs can supply the market, let alone oversupply the market, going forward. The other country I wanted

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to ask you about was China. When you did your world tour and talked about where production occurred, China was conspicuously missing, and by 2030 we expect China to be the world's largest consumer of uranium. Yet they don't really produce a significant amount domestically, so maybe you could talk about that a little bit.

Chris: You know, I think China, as they began to ramp up their nuclear program, say, about ten years ago, they sort of had a long-term goal of trying to source one third of their uranium needs internally, one third from purchased foreign assets—so they were gonna go out and buy mines in other countries—and then one third from the market. And we've not seen a lot of progress on the internal production as you mentioned, sort of minimal internal uranium production, and they have bought some assets. As I mentioned before they have the Husab mine in Namibia, which they are ramping up, and they bought some other assets in Africa, as well. So, we believe they are going to be, probably by the end of the decade, the leading source of demand, certainly the leading source of demand growth over the next ten years. Now they have built up a pretty large strategic inventory over the last ten years as prices were low, as the Chinese frequently do in a lot of commodities, but we think that they're gonna want to hold a fairly large, multiple-years'-worth of inventory, strategically since they don't produce any internally. So, we think as they continue to ramp up,

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they're gonna continue to be a source of demand on the global market just because they don't have any internally.

Daren: Yeah, I think the point of their inventory levels is really important. We will, in the future, do an entire conversation on global inventory because that's also key to our bullish thesis. It's also key to the skeptics who think the world is awash in inventory, and China would be one of those sources of inventory. But for today's purposes, because China can't possibly produce all of their uranium from captive sources, we believe strongly that marginal economics will drive the price of uranium. Because we get push back from, again, a lot of people new to the industry that say, "Well, China's a communist country. If nuclear is as important to their energy plans as you say, they're not gonna produce based on marginal economics, they'll produce whatever uranium that they need at whatever cost it takes to get it out of the ground." So, because they don't have domestic supply, they, at least currently, don't have a road map to own the assets in Africa or other parts of the world to supply their own captive uranium and regardless of price, we believe that they'll be on the market buying and they'll be buying from commercial producers that will have to get a return on capital for that production. So that's a shortcut—

Chris: Yeah, that's right.

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Daren: A lot goes into that conclusion, but that is the high-level conclusion that we've come to. So, you mentioned earlier the Kazakhs mine with a process called in-situ recovery—the shorthand's ISR—and they're not the only ones that do that, that production exists around the world. But I want to tie that into the cost curve. So, there are two ways to get uranium out of the ground: the one that you mentioned earlier, and then there's the traditional mining where you have to use big yellow equipment to dig it out of the ground. And then you also mentioned earlier in the conversation that there's different grades, you know, so even though uranium isn't that necessarily hard to find, it's hard to find in large quantities that are economic to mine. So, that was a long-winded introduction to the concept of the cost curve, and the cost curve is really why we establish a price target of sixty-five dollars. We know that the—or we believe—that the world is going to need at least a hundred and seventy-five million pounds of primary supply per year, growing to maybe as much as two million pounds over the next ten years, of primary supply coming out of the ground which will be driven by the marginal economics. And the reason we've established a price target in the sixties or above is because at that level of production the cost curve suggests the producers will need to get at least sixty-five dollars, and that's based on something called the AISC. What does that stand for, Chris?

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Chris: Yeah, the All-In Sustaining Cost.

Daren: Maybe you could talk to our listeners about that all-in sustaining cost. Does it really capture everything?

Chris: Yeah, I think that's the goal that is just to try to capture the cost to mine it on a cash basis. You see a lot of talk about the cash cost because that's sort of something that in the short-term companies can produce at that level and break even, but over the long-term they have to continue to reinvest capital to sustain production at that level, and so there are additional costs beyond the cash cost, so that's what they're trying to get at when they do that. And then one thing to point out, too; a lot of people look at the cost curves. Those cost curves do not include any kind of returns in there, so if you want to add returns on top of the cost curve that's usually another ten to fifteen dollars a pound. And so, when we look at the cost curve, in the big picture, if you want to divide it into quartiles—the lowest twenty-five percent of mines have costs, you know, at twenty dollars a pound or below, so they've been sort of...they haven't really lost money even as the price got down into the low-twenties. And then the next quartile—so up to fifty percent of supply—has costs up to thirty-five dollars a pound. And then when you look at the third quartile, all-in sustaining costs are sort of forty to forty-

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five dollars a pound. And then when you get into the high-end of the cost curve, you're looking at fifty dollars to sixty dollars plus per pound. And so, those are the marginal costs of miners, and then as I mentioned before the costs are, say, fifty to sixty, and then if they want to earn a return on that, you've got to add another ten to fifteen dollars a pound, so that gets you into a sixty to seventy-five dollar a pound range for the marginal cost plus the return. And so, that's sort of where we came up with the price target for the uranium commodity because eventually, as Daren mentioned earlier in the call, when we get short of supply that's gonna be the place where the price gets set. And I guess one other thing to mention there; I mentioned that China has a mine in Namibia. It's called the Husab mine, and just looking at the economics of that mine, it cost them over two billion dollars to build it, it's an open-pit mine and those mines usually cost somewhere between one-and-a-half to two, two-and-a-half billion dollars, so that's probably fifteen dollars a pound on the capital side, and then their cash cost is thirty to thirty-five dollars a pound so that a cost in the forty-five to fifty dollar range, and so that's in the third to fourth quartile and that's sort of an example of a recently built, large mine. So, to earn a thirteen percent return, that mine would need a sixty-five dollar a pound price for uranium.

Daren: Yeah, that's perfect, and that's also the last

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meaningful mine to come online. You know, one other thing on the cost curve; so, when you go through the quartiles, and I think it's important for our listeners to know also that the fourth quartile only gets you out to the hundred-and-fifty-million-pound range. So right now, there isn't even capacity to produce above a hundred and fifty, maybe a hundred and sixty million pounds, and so at that level the AISC is at that sixty-five, seventy-dollar range and it's very steep. So, let's talk about...we'll start with the good news, or at least the supply reductions. Because there aren't that many mines around the world and people understand the resource, we believe we know which mines are going to be depleted over the next, say, three to five years. So, there will be mine closures regardless of the price of uranium just because the mines become depleted. What are some of the most important ones we know about that will be coming offline?

Chris: I mentioned before that there are some mines in Niger that are owned by Orano. Those produce about seven million pounds a year. One of them, the Cominak mine, is now scheduled to close in 2021, and the other mine, the Somaïr mine, has similar cost structures—they both have maybe forty-five to fifty-dollar a pound costs. We believe that one is likely to close probably in 2022. And then, sort of the big one out there is Cameco's Cigar Lake mine. It's a world-class mine; about eighteen million pounds a year, very high-

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grade uranium, low costs—costs in the mid-to-low-thirties per pound. That mine is scheduled to come offline and be depleted around 2027 or 2028. And, you know, there is a potential for Cameco to invest more capital in that mine and allow it to continue to produce, but Cameco's CEO has already said that in order for them to do that they would've already had to have started investing in that. So, even if they do do that, even if they do get incentivized by prices and contracts to do that, there's gonna most likely be a gap in that production. But at this point it's just scheduled to close, so that would be, on the current supply base of a hundred and thirty-five million pounds, that would be about a thirteen percent decline in supply just from that one mine.

Daren: Yeah, and in uranium terms—or in terms of operating a nuclear facility—2027, 2028 is very, very soon in terms of planning purposes. We'll do a whole other conversation and another podcast talking about the long-term contracting cycle, but I just wanted listeners who might have heard that number and think, "Well, I don't want to be involved with these stocks for the next several years before there's a supply deficit," to know that that's not really what we're describing. We're really talking about a supply deficit that's going to occur in the next couple years, and if you look out even beyond the next couple years it gets extreme—like, a thirty percent supply deficit in the out years, like when that Cigar Lake

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goes offline. And it really can't play out that way. Something has to happen, and of course our thesis is what we believe is going to happen is the price of uranium is gonna go up. So, let's talk about the supply response when the price of uranium goes up, because there are also people that believe that there's enough shut-in capacity that maybe in the forties that shut-in capacity comes back online and that's enough to satisfy the market. But that's not our view, so maybe you could take people through what capacity is likely to come on first.

Chris: Maybe I should take it back a step and say: last time we talked about demand. Demand is in the neighborhood of two-hundred million pounds a year right now in terms of consumption. Mine supply was scheduled to be about a hundred and thirty-five million pounds this year, that's gonna be down to a hundred and fifteen million or lower as a result of Covid, but let's use a hundred and thirty-five million. Then there's also something called secondary supply. That number is about thirty-five million pounds this year. And then the third source of supply is, as we talked about earlier, inventories. And so, we have a structural shortage; demand is two-hundred million, mine supply and secondary supply are a hundred and seventy million. The other thirty million is coming from inventory draw down. So, we think there are a lot of inventories that were built up after Fukushima. We think maybe only half of those are gonna

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be for sale, and of that half we think those are going to be gone by the end of this year, and so that's setting the stage on supply. So, then what's going to come back and maybe replace that commercial inventory, that gap that's being filled by commercial inventories right now? First of all, we would assume that Cameco's McArthur River mine would come back. That's sort of one of the best mines in the world; eighteen, nineteen million pounds a year, very low costs, high-grade ore. That would bring back, let's say, nineteen million pounds. We think the Paladin mine will come back—that's probably another four or five million pounds. We think that Kazakhstan will ramp up to their original production goals—that's another ten million pounds. And then there's some U.S. suppliers that use the in-situ recovery method that is fairly low-cost—you know, in the thirty, thirty-five dollar a pound range—that could also come back. So, when you add all that up you might get to somewhere around forty million pounds, but all the while demand is growing, as well so, all that stuff restarting that has shut down would really only get you back to something a little bit short of demand, still. So, there's not all this excess closed-in supply out there waiting to come back on the market and create a new imbalance. It's going to have to come back on just to try to keep up with demand. As we said, demand's growing one to two percent a year so, if you look out to 2022, demand's gonna be two-hundred-and-six million pounds, the shortfall then is gonna be somewhere in the...forty to

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forty-five million pounds, and so all that forty needs to come back and we're still gonna be short. So, I guess that's what we have in terms of the ability of shut-in supply coming back. We don't think it has a major impact on the supply-demand imbalance that we see.

Daren: That was a great overview. And for context on the McArthur River [mine] that's owned by Cameco: operations were suspended even though it was a very healthy, low-cost mine, as you said, because of market conditions. And Cameco looked at the situation and looked at their forward order book and said, "We're better off suspending operations here," and they took that offline late 2017 and then subsequently said, "We're not gonna bring it on until we have long-term contracts at attractive prices in our books." And they've been pretty adamant that those prices have to be in the forties with escalators—so, let's just say, something around fifty—before they even consider reopening that large mine.

Chris: Yeah, that's right, I forgot to even mention that. They can reopen but they're not going to until they can get those contracts up near fifty dollars a pound, as you said. And then once they get that it's still gonna take them a full year to get to full production, so it's gonna take them a while to ramp back up to...so there's gonna be a lag on that supply response, as well.

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Daren: So, if we're right, and existing shut-in supply is not going to be enough to supply demand mid-2020s and the second half of the 2020s, and there has to be new mines brought online, who out there could bring on incremental new supply?

Chris: The big one out there is NexGen's Arrow mine in Canada, in the very productive Athabasca region of Canada. And that mine, they've done a lot of work on it, and it looks like their projections are that it's gonna be like a twenty-five million pound a year mine with costs probably in the low teens. It looks like a very good project. That looks like the first big supplier response that will happen in the upcycle as pricing improves. But again, as we mentioned, Cigar Lake is eighteen million pounds a year and that's scheduled to shut down in 2027, [20]28. If things go well for NexGen they might be able to get online a little bit before that, but their mine will be coming on sometime pretty close to when Cigar Lake is closing. And then there's another, you know, there's a number of small U.S. producers as I mentioned, they have some stuff that they can bring back, then they have additional projects that might bring [in] another couple million pounds a year. There are projects out there, it depends on what kind of production they are. As we mentioned the ISR production is sort of lower up-front cost because you don't have to build a big mine, so that can respond fairly quickly. And then the

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other projects like the NexGen Arrow project are bigger mines that are gonna require a fair amount of up-front capital in the hundreds of millions and billions of dollars, and so all those projects that are out there are gonna need to sign contracts at good prices to even be able to break ground and to be able to finance themselves. So, when we look at all the projects around the world and we look at the fact that Cigar Lake is gonna close, the mines in Niger are likely to close, there's just a natural depletion in the industry—even if all the good projects that could come on at a price, you know, in the forty to fifty dollar range come on, we still don't see that actually really creating a supply surplus, either.

Daren: And it's going to be tight, according to our models, even with all those projects getting completed. But—

Chris: Right.

Daren: They won't even start until—or at least it's our view that those projects don't even start until the price is significantly higher, and then we can reassess our supply and demand model as we go. But as of now it's very difficult for us to see how the industry meets demand beyond 2025, other than it coming from inventory. I mean, it has to come from...there is no chance that primary supply plus secondary supply can meet consumption. I mean, it's just math, it just doesn't exist.

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Chris: Right.

Daren: And that's with the shut-in capacity coming back online. So, new projects have to get started, in our view.

Chris: Yes. And, you know, the new projects—the open-pit mining projects—is where you get the big volume increases from, and those all take two-and-a-half, three years to build, and they take a couple years to permit, too. So, these companies in Canada—you know, Fission and Denison—they're moving the projects forward, they're in various stages of development and then they're moving ahead with permitting. But it's a multi-year process, so I think a lot of these mines, even in a best-case scenario, will not be producing for at least six or seven years.

Daren: You know, and I guess we're implying it but I'm gonna say it explicitly: it's important for people to understand that the industry has not been investing meaningfully in incremental capacity. So, they've been doing the permitting, they've been doing some exploration, but in terms of real capital to replace depleting assets, it just didn't happen. It hasn't happened for close to a decade now. There's just no backlog of projects that can come onstream in a few years. They're all basically at the starting line and so it's gonna take, maybe in Africa in friendly

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jurisdictions, four or five years if they really put the pedal to the metal and everything goes well, to bring on what we would consider a middle-sized project, and all that does is replace some of these other mines that are reaching the end of their lives. And then for a big project in a jurisdiction like Canada, you're looking at eight years, maybe ten years, before you bring on a really big project like NexGen. And I know you said maybe they could come on before Cigar Lake gets closed in 2027, [20]28—that's absolutely best-case, and they'd have to start now.

Chris: Yeah.

Daren: And they aren't, because the price doesn't justify it.

Chris: Big picture is this industry has been very underinvested for the last seven, eight, ten years. One indicator is in the peak of the last frenzy in 2007, [200]8 there were upwards of four hundred companies that had either the title of uranium in their name or something to do with uranium, and now we're down to something around forty companies. And also, the value of a lot of the uranium stocks are down somewhere in that neighborhood, as well; eight-five, ninety percent. Usually a good place to look for industries that are about to rebound is when capital has fled the industry for multi-year periods.

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Daren: Yeah.

Chris: There's no investment, there's no new projects that are really ready to go and so it's gonna take a while. Like you said, it's gonna take a while for the supplier response and we think it's gonna be needed soon and unable to be provided that quickly. So, we think the uranium commodity is going to get allocated by price. We think the price should go to where the marginal cost is, in the sixty-dollar plus range per pound.

Daren: Yeah, and I guess—again, it's implied but we haven't said it explicitly—our price target is based on the marginal cost of production with a return on capital, which really implies a long-term cost, but we all know when there's a supply deficit in a commodity you never really stop at marginal cost of production. Just like when there's an oversupply you don't stop at the marginal cost of production, you get way below it like we did during this bear market in uranium. This is a supply story, so it definitely deserved a little extra time, and there's probably still more to talk about, but we had this supply thesis in place, and it was playing out as we expected, and things looked great even before Covid. And you already mentioned it earlier in our conversation but actually Covid has accelerated our supply thesis, so maybe you can run through that quickly.

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Chris: Yeah, sure. So, as a result of Covid Cameco has temporarily closed its Cigar Lake mine, that's a mine in Canada. There's a Native population there that they are concerned about because of past problems in the 1918 Flu pandemic, and so that's an eighteen million pound a year mine. It's currently closed indefinitely, so we don't know when that's gonna reopen but probably not until they feel safe about their employee base and about the Native population that lives there. In addition, Kazakhstan announced March that they were suspending a lot of the pre-drilling operations for their ISR mines, so as they go along, they have to keep drilling ahead to allow for future production. That's very man-power intensive, so they stopped that piece because of concerns about the spread of the virus, and so they estimated that that was going to be about a ten million pound a year reduction in their 2020 supply, and we don't know if that is going to continue beyond June, but based on some of the reports that we hear out of Kazakhstan it does seem like there's still a pretty high concern over there about the Coronavirus. That could continue longer than people think. And then Namibia also closed down the mines there for several months, as well. So overall, as of now, we're modeling a sort of twenty million pound a year hit to uranium's mine supply for 2020, so going from a hundred and thirty-five million pounds to a hundred and fifteen million coming out of the mine, and so that sort of accelerates our inventory depletion story. So, commercial inventory is coming

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down by maybe thirty-five million pounds this year, now we see that coming down to more like fifty to fifty-five million pounds. And so, we think by the end of this year a lot of what people call "mobile inventories," meaning inventories that can be moved around and accessed and used by the utilities, inventories that are for sale, we think that most of those are going to be depleted by the end of the year. Where are people gonna get their uranium going forward? And so, the price needs to start going up.

Daren: And we covered this on the demand side, but it's worth reiterating that Covid does not impact demand directly. Because uranium's used in base-load electricity generation with nuclear power plants, a recession doesn't cause the owners of those nuclear power plants to shut them down, not really. They can do things at the margin, but it's not the marginal source of energy during recession so they just keep running. So, demand is basically unchanged, and supply is going to be lower by at least twenty million, and the longer this goes on the more it affects supply. So, again, this is gonna run long, but I think because it is a supply-driven thesis, let's get into secondary supply. There's only three sources of uranium: it comes out of the ground, which is also called primary supply, and that's what we've talked about almost exclusively so far; there's something called secondary supply; and then, of course, there's inventory that can be worked down, but we think that that's pretty

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much run its course. But secondary supply is actually a consistent source of supply, and you mentioned earlier it's around thirty-five million pounds. So, if it doesn't come out of the ground, but it's not inventory depletion, what is it? What is secondary supply?

Chris: Well, it is uranium that has previously come out of the ground, I guess, in some ways. There are several different components of what the industry calls secondary supply. One component is sales of leftover Cold War surplus stocks held by the U.S. and Russian governments and militaries. They take weapons-grade uranium and down blend it into uranium that can be used in power plants. That's a small piece. There's also recycled uranium. So, we think those two pieces together are maybe about ten to twelve million pounds a year of fairly consistent supply. And then the bigger piece that is more of a moving target is what the industry calls underfeeding, and what I might try to explain a little more easily as re-enriched uranium. So, when you first make uranium that is useable in a nuclear reactor, you have to enrich it, and you enrich it by spinning it in a centrifuge. And then, once you do that, there's extra stuff they call depleted "tails" that's left over. And so, those can be put back into your centrifuge and spun a little longer to create more supply. That supply is about twenty-five million pounds a year, but it used to be maybe closer to ten or twelve million pounds a year.

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It increased in the downturn here because it's more economically feasible to put those lower-grade, used uranium [tails] back into the centrifuges and spin it to create more when demand is low and when the cost of the end product is low. But, as the price of that end product increases, the incentive to spin only new uranium in your centrifuge increases. We think that that number, maybe in the twenty-five million pound a year range, is gonna decline here over the next couple of years as the market for the enriched uranium has already begun to improve. And so, that means, in our model we have sort of secondary supply going from somewhere around thirty-five million pounds down to somewhere around twenty to twenty-five million pounds over the next three or four years. So, that's kind of like losing a pretty big uranium mine, also.

Daren: And that level of secondary supply is consistent with what it used to be when capacity for centrifuges was tighter and the price of the fuel was higher. Is that correct?

Chris: Yes.

Daren: Let me take a stab at my interpretation of it. So, because utilities felt like they had plenty of inventory, that the fuel was readily available, demand for enrichment was low. So, if you owned these facilities, based on utility demand you might only operate at, let's say, seventy percent. And so, what

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the owners of these assets did is they filled up the incremental thirty percent of what would have been idle capacity by running—generically, I call it “scrap.” In the industry they call it “tailings,” right?

Chris: Right.

Daren: So, they take the scrap at the end of the process and they run it through the centrifuge again. And that might take twice as long—it’s not a very efficient way to create fuel—but they didn’t care because their assets would be sitting idle otherwise. But that created supply. That’s why supply went from twenty million pounds from that source up to thirty-five, because otherwise it would have just been idle capacity. So, they’re squeezing more out of each pound of raw uranium, but they’d rather use their assets to just run the uranium through once because that’s extremely efficient, and then they can discard of the scrap instead of running it through the centrifuge again. So, that’s kind of the economic reason why, from the owners of those assets, it’ll make more sense for them to stop selling it that way, stop creating that incremental supply. Our thesis doesn’t hinge on that, but it’s kind of an interesting dynamic and it will be, like you said, like one really large mine coming offline.

Chris: Right.

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Daren: You know, we have a lot of other resources to explain secondary supply. That probably also deserves an entire half-hour discussion, but I wanted to introduce it because that is an important source of supply and it does complicate the story. But the bottom line here is that consumption is around two hundred million pounds, primary supply is all the way down this year to a hundred and fifteen million pounds, I mean, absurdly low compared to consumption. And the secondary supply is around thirty-five million this year, but going forward we expect, even if we normalize primary supply to around a hundred and thirty million—but then we normalize the secondary supply to something closer to twenty, twenty-five million—you still have this fortyish million-pound gap per year. And there is nothing to close that gap except for commercial inventory, until the price recovers to bring on what's currently shut-in supply, but hopefully we explained that even after that shut-in supply comes back on the market, it's not going to be enough to meet consumption. So, eventually there will have to be a new mine, and that new mine isn't going to get started until the price is much higher, past the marginal cost of production. So, that is really the heart of our thesis, it's why this podcast is going to run longer than half an hour, but hopefully it was worth it and we appreciate your interest in our uranium thesis and thank you, Chris, for all of your hard work in this area and helping our

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listeners understand the supply dynamics of the uranium market. Pretty exciting stuff.

Chris: Very exciting.

Daren: Alright, thanks again, Chris, and I will talk to you soon, and thanks to our listeners for your interest.

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